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EP 0548751 A **US 4481804 A**

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(54) Gas sensor apparatus with maintenance information

(57) Gas sensor apparatus 2 for measuring the concentration of a gas, comprises gas sensor 4, circuit means (6) providing a voltage output in dependence upon the concentration of gas sensed by the gas sensor 4, and memory means 8 containing maintenance information for enabling a user to know that the gas sensor apparatus 2 should be operating in a reliable manner. The maintenance information may include details of the last calibration and calibration factor, and also date of manufacture, expected life, type of gas sensed, volume concentration and recommended calibration period. The gas sensor 4 is preferably a fuel cell. The sensor is associated with a control unit which displays the sensor output and can read and write to memory means 8.

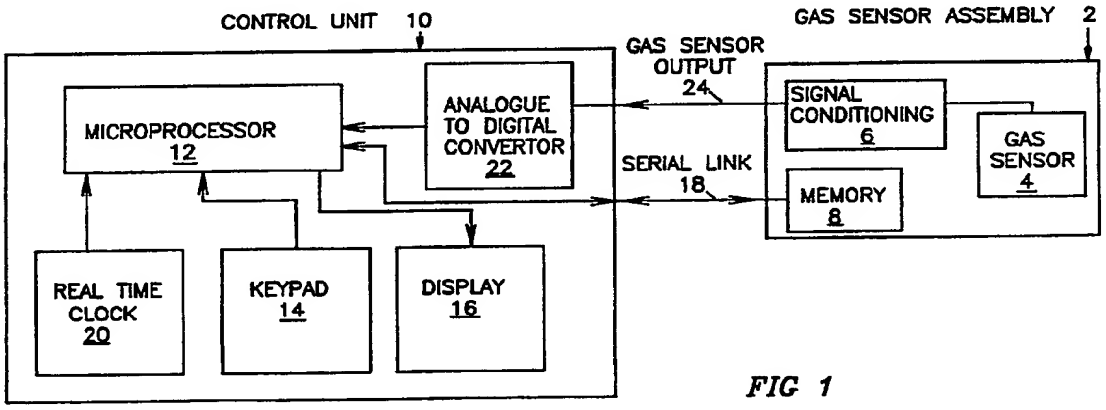

FIG 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

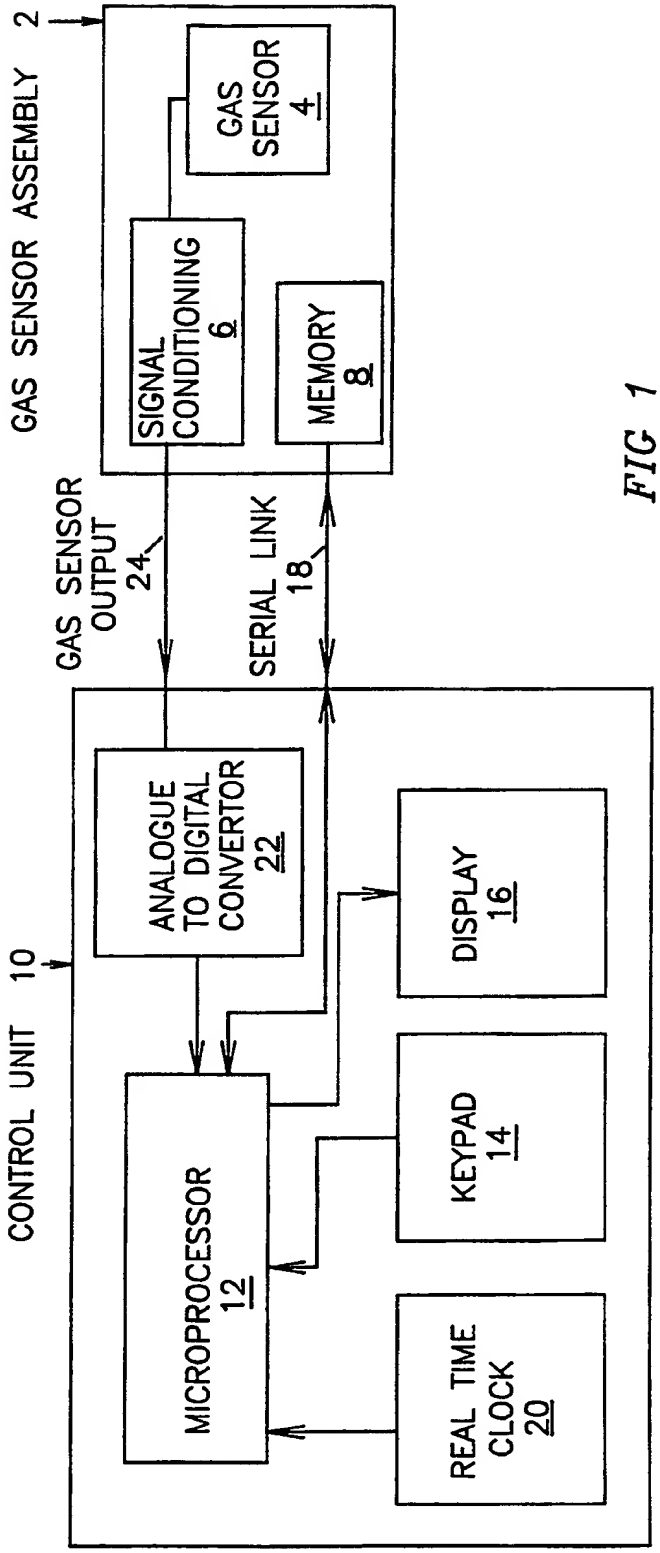

FIG 1

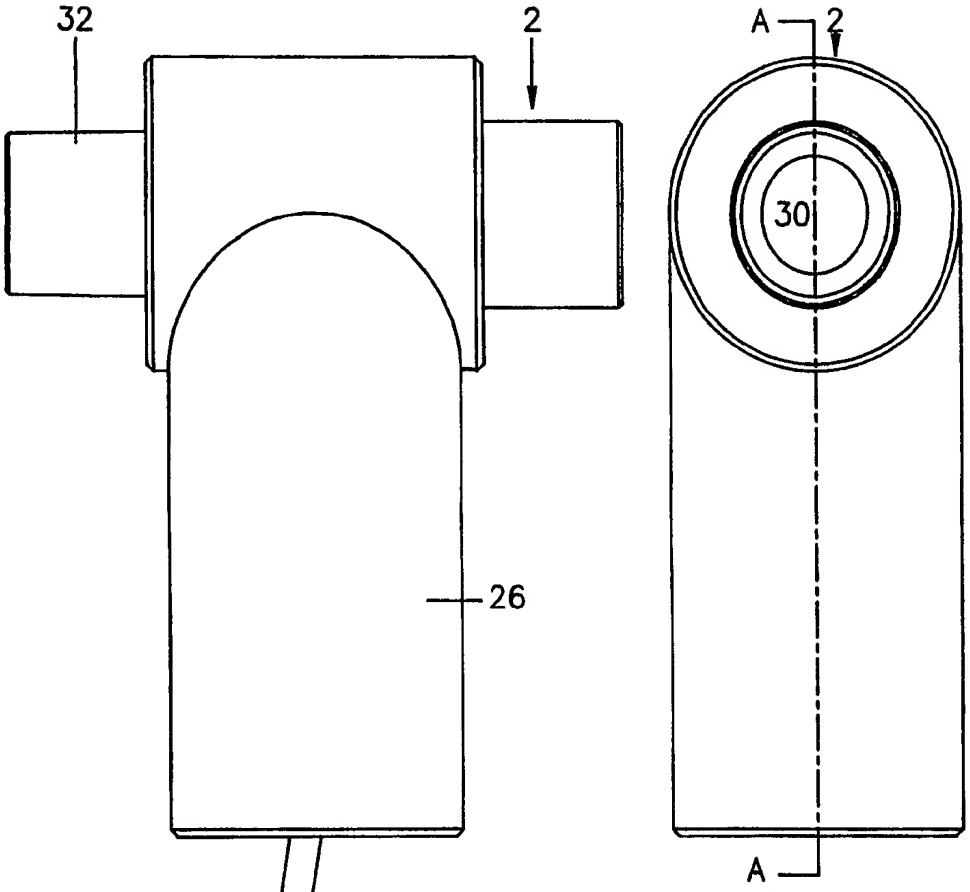

FIG 3

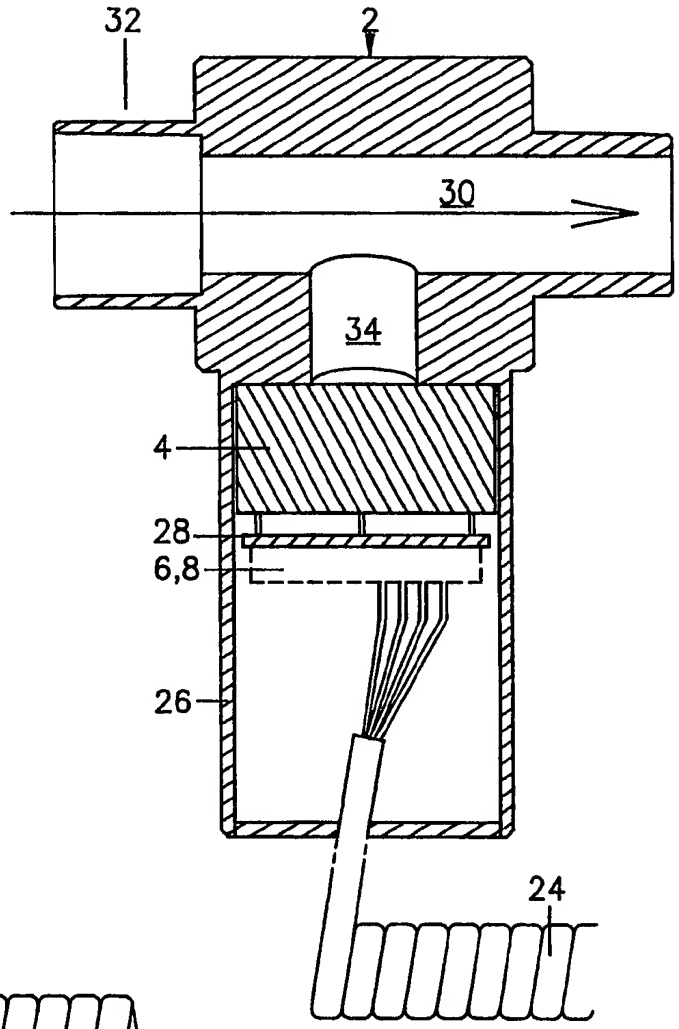

FIG 4

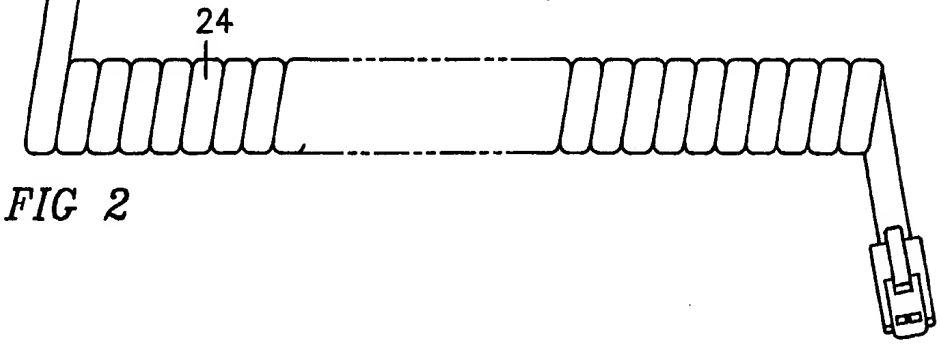

FIG 2

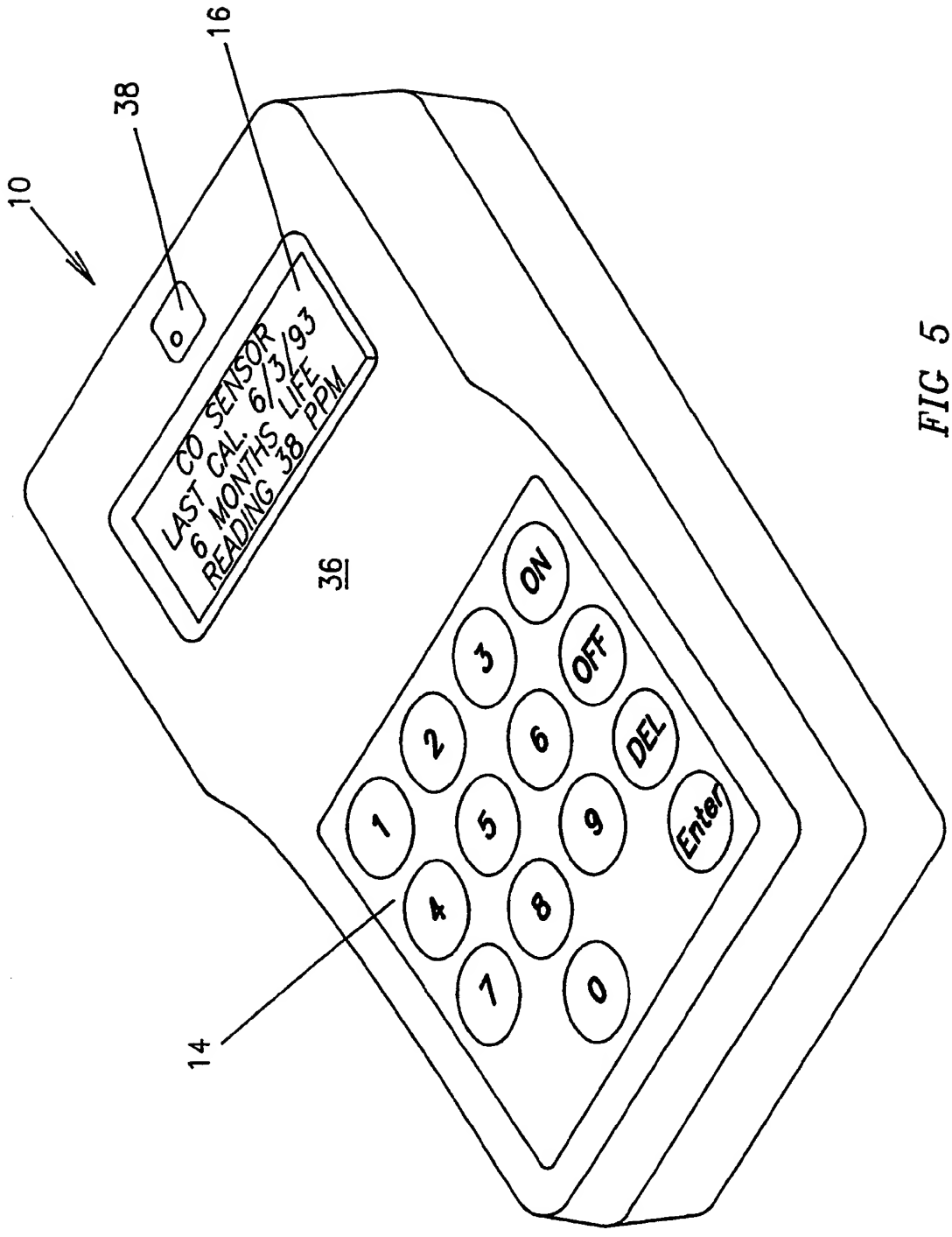

FIG 5

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GAS SENSOR APPARATUS

This invention relates to gas sensor apparatus and, more especially, this invention relates to gas sensor apparatus for sensing the concentration of a gas.

In hospitals, nursing homes and similar establishments, it is often necessary to measure the concentration of a gas. For example, intensive care units in hospitals often administer nitric oxide gas to patients and it is essential to know the concentration of the gas. Examples of other gases often requiring to be measured for their concentration are oxygen, hydrogen chloride and hydrogen sulphide.

Gas sensor apparatus is known which uses gas sensing means for sensing the concentration of a gas. The gas sensor apparatus is such that it is able to determine the concentration of one gas only so that separate gas sensor apparatus is required for each gas being tested. The known gas sensor apparatus employs gas sensing means in the form of a fuel cell. The fuel cell reacts with the gas under test in order to give a measurement of the concentration of the gas.

The known gas sensor apparatus is such that it requires frequent recalibration for accuracy, and it requires replacement after one to three years, depending upon the type of the gas sensor apparatus. The gradual

decline in sensitivity and the requirement for replacement is mainly due to the use of the fuel cell as the gas sensing means. The fuel cell does however provide an inexpensive and compact means for enabling the measurement of the concentration of gases.

In view of the requirement of the known gas sensor apparatus for frequent recalibration and eventual replacement, it is recommended that users of the known sensor apparatus keep a record of each calibration, and also a record of the expected expiry date of the gas sensor apparatus. As a practical matter, the gas sensor apparatus is likely to be used by lots of different people and the required records are not maintained. This results in users not being sure if the gas sensor apparatus is working accurately and/or has passed its normal recommended life period. This in turn results in the gas sensor apparatus not being used and it is commonplace in hospitals to find storerooms full with gas sensor apparatus that is not being used because the accuracy of the gas sensor apparatus is not known and faulty measurements cannot be tolerated where human lives are at risk. This storing and non-use of large numbers of gas sensor apparatus represents a very considerable waste of money, as does the need to use new gas sensor apparatus each time the concentration of the gas needs to be measured and the existing gas sensor

apparatus cannot be trusted because there is no record of its calibration history and/or its use expiry date.

It is an aim of the present invention to obviate or reduce the above mentioned problem.

Accordingly, in one non-limiting embodiment of the present invention there is provided gas sensor apparatus for sensing the concentration of a gas, which gas sensor apparatus comprises gas sensing means, circuit means for providing a voltage output in dependence upon the concentration of gas sensed by the gas sensing means, and memory means containing maintenance information for enabling a user to know that the gas sensor apparatus should be operating in a reliable manner.

The importance of providing the memory means in the gas sensor apparatus cannot be over emphasized. Users in hospitals and other establishments are no longer in the position where there have no confidence in the gas sensor apparatus and they either have to take a chance and use the gas sensor apparatus, or use new gas sensor apparatus which is expensive, and which consigns the old gas sensor apparatus to a storeroom or a rubbish bin. Manual calibration, for example using a wall chart, is avoided with its attendant problems of different users and different working shifts. The use of the memory means ensures that any user of the gas

sensor apparatus of the present invention can know for certain whether or not the gas sensor apparatus should be operating in a reliable manner. The need to take a chance on using gas sensor apparatus of uncertain accuracy is avoided, as is the need and expense to use new gas sensor apparatus to throw away used gas sensor apparatus that may be working perfectly satisfactorily. Hospital storerooms will no longer need to be crammed full of gas sensor apparatus which just stays there because the accuracy of the equipment is not known and personnel do not have the time or the experience to check the apparatus and re-calibrate it if necessary.

The maintenance information in the memory means will usually be such as to include details of the gas for which the gas sensor apparatus has been designed. With such information, a single control unit can be used to calibrate lots of different types of gas sensor apparatus because the control unit is able to establish the particular type of gas sensor apparatus under test, for example one for sensing the concentration of nitric oxide, or one for sensing the concentrate of oxygen, and to then permit recalibration appropriate for that gas sensor apparatus.

Preferably, the gas sensor apparatus is one in which the maintenance information in the memory means is of first and second types with the first type of

maintenance information being that which is written into the memory means at the time of manufacture of the gas sensor apparatus and which is never changed, and with the second type of maintenance information being that which is updated everytime a calibration is performed.

The first type of maintenance information may comprise the following:

1. Date of manufacture.
2. Expected useful life.
3. Type of gas sensed.
4. Volume concentration, for example as parts per million or as a percentage.
5. Recommended calibration period.

The second type of maintenance information may comprise the following:

1. Date of last calibration.
2. Calibration factor.

The gas sensing means is preferably a fuel cell.

The gas sensor apparatus may include passage means for being breathed into by a patient, the gas being tested then being the air exhaled by the patient.

The present invention also extends to the gas sensor apparatus when connected to a control unit.

The control unit may comprise a microprocessor, a display panel, a bi-directional serial data link to the memory means, an analogue to digital convertor for receiving the voltage output from the circuit means, and a keypad. The control unit may also comprise a real time clock.

An embodiment of the invention will now be described solely by way of example and with reference to the accompanying drawings in which:

Figure 1 shows in block diagram form gas sensor apparatus connected to a control unit;

Figure 2 is a side view of the gas sensor apparatus;

Figure 3 is a front view of the gas sensor apparatus;

Figure 4 is a section on the line A-A shown in Figure 3; and

Figure 5 is a perspective view of the control unit.

Referring to Figure 1, there is shown gas sensor apparatus 2 for sensing the concentration of a gas. The gas sensor apparatus 2 comprises gas sensing means 4, circuit means 6 for providing a voltage output in dependence upon the concentration of gas sensed by the gas sensing means 4, and memory means 8. The gas sensing means 4 is in the form of a fuel cell. The

circuit means 6 is in the form of a signal conditioning circuit. The memory means 8 contains maintenance information for enabling a user of the gas sensor apparatus 2 to know that the gas sensor apparatus 2 should be operating in a reliable manner.

The maintenance information in the memory means 8 includes details of the gas with which the gas sensor apparatus 2 is designed to operate. The gas may be, for example, nitric oxide or oxygen. The maintenance information in the memory means 8 is of first and second types, with the first type of maintenance information being that which is written into the memory means at the time of manufacture of the gas sensor apparatus 2 and which is never changed, and with the second type of maintenance information being that which is updated every time a calibration is performed. More specifically, the first type of maintenance information is as follows:

1. Date of manufacture.
2. Expected useful life.
3. Type of gas sensed.
4. Output in parts per million
   or as a percentage.
5. Recommended calibration period.

The second type of maintenance information is as follows:

1. Date of last calibration.

2. Calibration factor.

As shown in Figure 1, the gas sensor apparatus 2 is connected to a control unit 10. The control unit 10 comprises a microprocessor based control circuit 12 which interfaces to a keypad 14, a liquid crystal alpha numeric display 16, a bi-directional serial data link 8 to the memory means 8, a real time clock 20, and an analogue to digital convertor 22 for reading the output of the gas sensor apparatus 2 via a lead 24.

During operation of the gas sensor apparatus 2 and the control unit 10, the control unit 10 reads the information from the memory means 8 in the gas sensor apparatus 2, and displays on the display 16 information regarding the type of gas sensor connector, the expected useful life remaining, whether calibration is now required, and the measurement obtained from the gas sensor apparatus 2 via the analogue to digital convertor 22. When a user recalibrates the gas sensor apparatus 2 via the control unit 10, the new calibration factor and the date of calibration are written into the memory means 8. Thus the required calibration record is easily and simply stored with the sensor apparatus 2, and is able to be reproduced automatically. The gas sensor apparatus 2 can also be discarded at the appropriate time from the illustrated date of manufacture and not

before. Also, very advantageously, one of the control units 10 is able to obtain data from a plurality of pieces of gas sensor apparatus 2 each for sensing different types of gases. This is made possible because the control unit 10 receives information from each individual piece of gas sensor apparatus 2 indicating a type of gas that is sensed by the gas sensor apparatus 2. The control unit 10 then utilises from within its memory bank the information appropriate to the particular type of gas sensed.

Referring now to Figures 2, 3 and 4, there is shown one preferred construction of the gas sensor apparatus 2. As can be seen, the gas sensor apparatus 2 has a hand holdable body portion 26 which houses the gas sensing means 4, the circuit means 6 and the memory means 8. The circuit means 6 and the memory means 8 are mounted on a printed circuit board 28. During use of the illustrated apparatus 2, a patient blows air through a passageway 30 via a mouthpiece 32. A T-junction into a passageway 34 enables the exhaled air to contact the gas sensing means 4, and thus a desired reading to be obtained.

Referring now to Figure 5, there is shown a preferred control unit 10. The control unit 10 has a housing 36 containing the data entry keypad 14 and the display 16. As shown in Figure 5, the display 16 is a

liquid crystal alpha numeric display. The housing 36 also contains a connection socket 38 for the lead 24 shown in Figure 1.

It is to be appreciated that the embodiment of the invention described above with reference to the accompanying drawings has been given by way of example only and that modifications may be effected. Thus, for example, the gas sensor apparatus 2 may be differently designed to that shown in Figures 2 to 4, and the control unit 10 may be differently designed to that shown in Figure 5.

CLAIMS

1. Gas sensor apparatus for sensing the concentration of a gas, which gas sensor apparatus comprises gas sensing means, circuit means for providing a voltage output in dependence upon the concentration of gas sensed by the gas sensing means, and memory means containing maintenance information for enabling a user to know that the gas sensor apparatus should be operating in a reliable manner.

2. Gas sensor apparatus according to claim 1 in which the maintenance information in the memory means is such as to include details of the gas for which the gas sensor apparatus has been designed.

3. Gas sensor apparatus according to claim 1 or claim 2 in which the maintenance information in the memory means is of first and second types with the first type of maintenance information being that which is written into the memory means at the time of manufacture of the gas sensor apparatus and which is never changed, and with the second type of maintenance information being that which is updated every time a calibration is performed.

4. Gas sensor apparatus according to claim 3 in which the first type of information comprises

1. Date of manufacture.
2. Expected useful life.
3. Type of gas sensed.
4. Volume concentration.
5. Recommended calibration period.

5. Gas sensor apparatus according to claim 3 or claim 4 in which the second type of maintenance information comprises

1. Date of last calibration.
2. Calibration factor.

6. Gas sensor apparatus according to any one of the preceding claims in which the gas sensing means is a fuel cell.

7. Gas sensor apparatus according to any one of the preceding claims and including passage means for being breathed into by a patient, the gas being tested then being the air exhaled by the patient.

8. Gas sensor apparatus for sensing the concentration of a gas, substantially as herein

described with reference to Figures 1 - 4 of the accompanying drawings.

9. The combination of gas sensor apparatus according to any one of the preceding claims and a control unit.

10. The combination according to claim 9 in which the control unit comprises a microprocessor, a display panel, a bi-directional serial data link to the memory means, an analogue to digital convertor for receiving the voltage output from the circuit means, and a keypad.

11. The combination according to claim 9 or claim 10 in which the control unit also comprises a real time clock.

12. The combination according to claim 9 and substantially as herein described with reference to Figure 5 of the accompanying drawings.

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Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

Application number
GB 9322737.9

Relevant Technical Fields

(i) UK Cl (Ed.N) G1N (NACJ, NAHAD, NAHAR, NAHAS, NAHAT, NAHAX, NBAA, NBKT, NBKX, NBMX, NCGB)

(ii) Int Cl (Ed.6) G01D 18/00; G01N 27/416, 33/00

Search Examiner
D MOBBS

Date of completion of Search
7 FEBRUARY 1995

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASES: WPI

Documents considered relevant following a search in respect of Claims :-
1-12

Categories of documents

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	EP 0548751 A	(BAYER AG)	1, 2, 9
X	US 4481804	(HOFFMANN-LA ROCHE) see particularly column 4 lines 24-30	1, 9

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